CHARACTERISTICS OF A CONTAINER STUFFING ALGORITHM

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THESIS

CHARACTERISTICS OF A CONTAINER
STUFFING ALGORITHM

by

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(20. ABSTRACT Continued)

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The results of this work show how response variables are affected by combinations of environmental factors and operations parameters.

Characteristics of a Container Stuffing Algorithm

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ABSTRACT

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I. INTRODUCTION

The Department of Defense has made extensive use of the high seas for rapid, inexpensive, and relatively secure transportation of supplies and equipment necessary to maintain the overseas defense installations of the United States.

Since the beginning of World War II, the Department of Defense has made continuing strides in the development and shipment of larger unitized loads. The advantages of unitized loads are the speed and ease of handling at transportation interchange points. Palletized unit loads, large fiberboard containers and steel containers were used in this effort. Within the last few years the large-sized van containers have become increasingly popular for ocean shipments by both the military and industry.

As the shipping industry has adopted the containerization concept, DOD has complied with this mode for a high percentage of its export cargo in order to achieve the objectives of low cost and timely shipping. In fact, commercial containerships have become the primary means for transporting United States Department of Defense general ocean cargo in recent years. Many millions of dollars have been saved by the utilization of containers and containerships as opposed to the use of traditional breakbulk cargo ships. On the other hand, containerization has created some new operational problems. These problems are complex and difficult to grasp because of the numerous and varied elements involved.

The DOD transportation managers have responsibilities for shipping general ocean cargo to the individual overseas commands around the world. Overseas commands, referred to here as consignees, require material support from supply points (consignors) located in the Continental United States. The DOD transportation manager has to achieve low cost and timely shipping in order to maintain good service for customers.

There are several paths that cargo can take enroute from consignor to consignee. Certain cargo may be sent directly to the POE where it is loaded aboard conventional cargo ships (breakbulk ships) for the ocean voyage. In contrast, if the material to be transported is containerizable and in large enough quantities at the consignor, ocean shipping containers might be source stuffed, that is, the cargo is placed into containers at the consignor's warehouse, sealed and shipped directly to a POE for lift aboard a containership for ocean transport to the consignee.

Smaller quantities of containerizable cargo are shipped from the consignors to container stuffing stations where cargos for particular POE's or consignees are collected and stuffed into containers. Containerized cargo arriving at the POE is handled in one of two ways. Containers that have cargo for only one consignee are offloaded and sent directly to the consignee; containers holding cargo for more than one consignee are routed to breakbulk stations that service the

particular consignees and are unstuffed. The cargo is then segregated by consignee for further shipment to the individual commands.

In general terms, containerization offers substantial advantage when:

A. Shipments to a single overseas command or consignee can be consolidated in one container because this will minimize cargo handling cost and the problem of security;

B. Each container can be loaded to its maximum possible extent because ocean container transportation costs are solely dependent on the container, not on the volume or weight of the cargo in the container;

C. The frequent commercial containership sailings can be used to minimize the time it takes to move the cargo from origin to destination.

Trying to exploit these advantages creates some rather interesting management problems because of conflicting interactions. For example, trying to avoid mixing cargo destined for different consignees in a single van may inhibit the achievement of full van loads, or require extended delays of cargo at consolidation points.

There are many factors that could be considered when examining an operation as complex and diverse as a container stuffing operation. One group of factors are parameters regarding stuffing operations; they are average days between vessel arrivals, breakeven points, and container size.

Another group of factors are performance measurements, referred to here as response variables, such as average shipment delay, average container utilization and single consignee proportion. Response variables are a result of stuffing operation parameters.

The objectives of this thesis are two fold:

1. Identify response "ranges" for given operations parameters and simulation assumptions.

2. Identify the sensitivity of response variables to changes in operations parameters.

To achieve these objectives, a simulation model along with statistical data analysis techniques were used. Input data for the simulation model was derived from actual shipment data provided by the two Military Ocean Terminals at Oakland, California (MOTBA) and Bayonne, New Jersey (MOTBY).

Thirteen major overseas ports served by MOTBA and eighteen major overseas ports served by MOTBY were selected for analysis.

The simulation model and the shipment data was used to generate three hundred and sixty (360) days of operational data for each set of operation parameters. Stepwise multiple regression analyses was then applied to the output in order to find equations which identified the relationships between the operation parameters and response variables.

General background information is presented in Chapter II. The procedures of analysis, including the use of the

simulation model, are discussed in detail in Chapter III. The modification of the simulation program is also included in this chapter.

Chapters IV and V present the results of these analyses. Chapter IV describes the range of response variables, and Chapter V presents the sensitivity of response variables to changes in operations parameters.

Chapter VI is a concluding chapter. It is a summary of the results obtained in this thesis; it also discusses how these results can be used by transportation managers.

II. BACKGROUND AND DEFINITIONS

Briefly, the DOD organizations responsible for the various components of transportation are as follows. The Military Traffic Management Command (MTMC) is, for the most part, responsible for the management of CONUS activities, the Military Sealift Command (MSC) is responsible for coordinating the ocean movement with commercial carriers, and theater transportation managers are responsible for overseas activities.

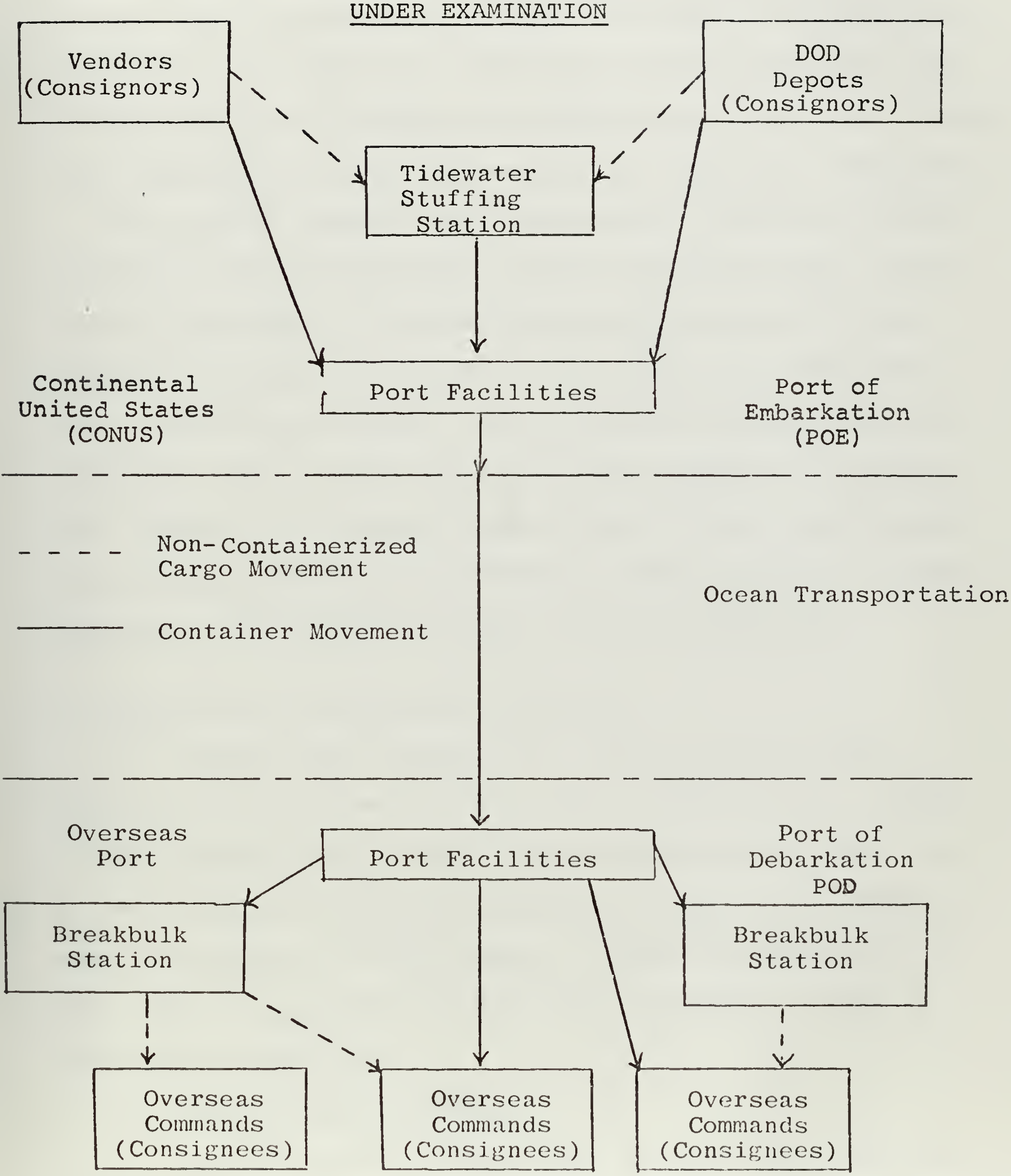
Figure 1 illustrates the portion of the Department of Defense transportation system with which this thesis is involved. The principal focus here is on the stuffing station which loads cargo into containers. The operations at this station affect the performance of the entire system.

If a container is stuffed with cargo going to one and only one consignee, then the container can be delivered directly to the consignee and unstuffed. In this case, it is obvious that the material handling cost and security problem are minimized. Containers eliminate the need for directly handling cargo on the piers and in the holds of ships. When the shipment is loaded into a container at the consignor's plant and unloaded at the consignee's door, the direct cargo handling is eliminated at intermediate points. This reduction in handling greatly reduces cost, especially damage and pilferage costs. However, the above can take place only if there are sufficient volumes of cargo going to a single consignee.

Figure 1

EXPORT CARGO MOVEMENT

UNDER EXAMINATION



If a container is stuffed with cargo of several consignees, then it would be delivered to a breakbulk station where it is unstuffed and the cargo is then delivered to the designate consignees. In this case, additional material handling cost is required, but it reduces the difficulty in having to accumulate cargos at the stuffing station for individual consignees.

This thesis examines some quantitative effects of various factors on the transportation system described above. Specifically, the impact of three operations parameters on five response variables are measured. The operations parameters are: average days between lifts; minimum container load requirement; and container size. The five response variables are: average and maximum shipment delay at the stuffing station; average container utilization; single consignee volume proportion; and single consignee shipment proportion.

A. DEFINITION OF OPERATIONS PARAMETERS

1. Average Days Between Lifts (ADBL) is the average length of time that accrues from the departure of one vessel to the departure of the next vessel destined for a POD. It is calculated by dividing the number of days in the period under consideration by the number of vessel departures to a POD. This is equivalent to the vessel schedule to pick up the stuffed container.

2. Minimum Load Requirement

The minimum load requirement controls the initiation of cargo stuffing into a container. It represents the volume

of cargo that must be on-hand for a container before the simulation model will begin loading cargo into the container. The minimum load requirement value is determined by taking the breakeven volume of the container and multiplying it by the breakeven adjustment factor.

a. Breakeven Volume

The breakeven volume is the minimum economically acceptable cargo volume that must be in a container before it can be closed out. This amount is derived from a comparison with non-containerized ocean shipping costs. For most PODs in the Pacific, the volume is around fifty percent of a container's volume. For this thesis, it is set at fifty percent of a container's volume for all PODs.

b. Breakeven Adjustment Factor

Breakeven adjustment factors are varied at (0.7), (1.0), (1.3) and (1.6). This means that the minimum load requirement is varied from thirty-five percent, fifty percent, sixty-five percent and eighty percent of the container's volume respectively.

3. Container Size

The common commercial ocean shipping containers range in approximate size from the small 8x8x20 foot van with volumes in the neighborhood of eleven hundred (1,100) cubic feet and weight capacities around forty thousand pounds, to large 8x8x40 foot containers which have volume in the twenty-four hundred (2,400) cubic feet range and weight capacities of around forty-six thousand (46,000) pounds.

For purposes of this thesis, only large (8x8x40, 2,390 cubic feet, 46,000 pounds) and small (8x8x20, 1,120 cubic feet, 40,000 pounds) containers were considered in the simulations.

B. DEFINITION OF RESPONSE VARIABLE

The results of stuffing operations are expressed for each POD in terms of the following response variables.

1. Average shipment delay (t)

This is the average time between a shipment's arrival at the stuffing station and its departure from the stuffing station. Shipments may be divided or "split" into segments while being loaded into the containers in order to stay within the volume or weight limitations of the container. It should be noted that those shipments with several segments are assigned an age equal to the age of the last segment to be stuffed.

2. Maximum Shipment Delay

This is the maximum time between a shipment's arrival at the stuffing station and its departure from the station. It is the maximum value experienced by any consignee served.

3. Average Container Utilization (u)

This is the average proportion of container space displaced by cargo. The utilization proportion is calculated by dividing the total volume of transported cargo by the total volume of the containers used to transport the cargo to the POD during the time interval under examination.

4. <u>Single Consignee Proportion (v)</u>

This variable is the volume proportion of cargo which moves in containers loaded solely with a single consignee's shipments. It is calculated by dividing the volume of cargo which moves in single consignee vans by the total volume of freight which moves to the POD during the time interval under examination.

5. <u>Single Consignee Shipment Proportion (s)</u>

This variable is the shipment proportion of cargo which moves in containers loaded solely with a single consignee's shipments.

C. DEFINITION OF THE ROLE OF SIMULATION IN DETERMINING RESPONSE VARIABLES FOR GIVEN PARAMETERS

A simulation model was used to identify how the response variables are affected by different minimum load requirements, ADBL, and container size. A container stuffing simulation model, developed by Dr. James P. Hynes, Assistant Professor, Department of Operations Research and Administrative Sciences, Naval Postgraduate School, was used to generate data for this analysis.

Generally, a simulation model mathematically replicates the major factors which operate in the modeled system. Simulation results can be used for absolute predictions, or for relative predictions [Ref. 7].

This thesis addresses both absolute and relative prediction roles. Identifying response "ranges" for given parameters

and simulation assumptions is the absolute prediction role. Identifying sensitivity of a response variable to changes in factors is the relative prediction role. In the relative role, the model is used to emphasize the relative differences between each factor by categories.

D. THE SIMULATION MODEL

The simulation model was instrumental in this thesis; a brief discussion of its principles and functions is imperative at this point in order to clarify its capabilities and to elaborate on methodology. Space and time restrictions prohibit a complete description of the simulation model and all its assumptions. Only the important features of the model are discussed. For complete documentation of the model, see reference [7].

The simulation model replicates the major factors influencing waterfront operations at the container stuffing station. This includes variations in vessel departures, shipment inputs, booking containers aboard vessels, and stuffing restrictions.

The program is divided into modules and their interrelationships with the data files and information stacks are depicted in Figure 2. Shipment arrivals, volumes, and weight are fed into the program on a daily basis and stored.

GENERAL INFORMATION AND RECORD FLOW

IN THE

SIMULATION PROGRAM

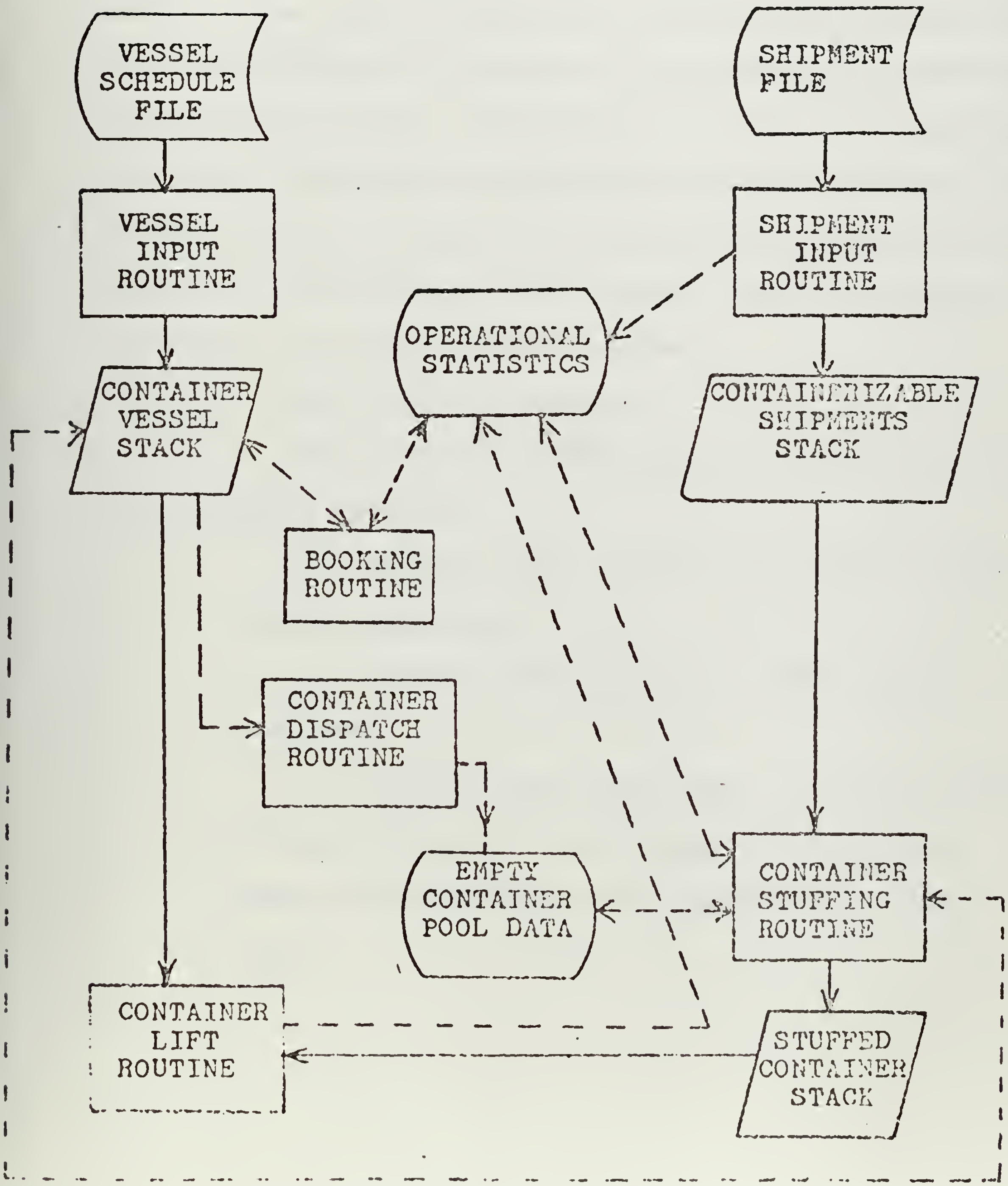


FIGURE 2

Information on future vessel arrivals, container types, and container availability are also fed into the computer program. The booking routine begins reserving containers aboard vessels according to accumulated cargo volumes and forecasted POD volume inputs. Several days before a vessel's arrival, the container stuffing routine begins cargo stuffing into the containers that can be loaded into the reserved spaces on the vessel. Containers are drawn from the empty container pool which is replenished by the container dispatch routine, which is keyed to the containers booked on arriving vessels. The container lift routine transfers stuffed containers on to the arriving vessels.

a) The Stuffing Routine.

The stuffing algorithm was formulated to include the following factors:

1. Maximum usable volume for cargo in each type of container.

2. Maximum cargo weight for each type of container.

3. Minimum load requirement in terms of the minimum volume of cargo that must be on hand before cargo stuffing into the container can begin.

4. Consignee mixing restrictions in terms of which consignee cargos (if any) can be mixed when necessary.

5. Minimum shipment splitting restrictions in term of the minimum allowable size to which a shipment can be split when necessary for stuffing.

6. The stuffing procedure is vessel oriented vis-a-vis cargo oriented. In short, the procedure used here initiates stuffing activities to meet vessel arrivals and departures, whereas a cargo oriented one would initiate stuffing activities solely on the basis of cargo accumlations.

Stuffing procedures are governed by two factors: the minimum load requirements and the stuffing lists. The stuffing lists are inputs to the simulation program which define the sequence in which the stuffing routine attempts to load cargo into containers, and at the same time also specifies which consignee cargos can be mixed. There are a set of stuffing lists for each POD. A stuffing list displays a set of consignees whose cargo can be mixed in a single container. The placement of consignees on a list, and the order in which each list is sequenced as input data controls how cargo will be stuffed by the routine. Also, each stuffing list specifies an adjustment factor which is used in conjunction with the breakeven point to determine the minimum load requirement. The stuffing list inputs to the simulation program provide the ability to influence the

proportion of containers which are loaded with single consignee cargo, the level to which containers must be filled before being closed out, and the various ways in which consignee cargo can be mingled.

The minimum load requirement controls the initiation of cargo stuffing into a container. It represents the volume of cargo that must be available for the consignees on a stuffing list before the algorithm will implement the stuffing list to load cargo into the container.

A few additional points need to be mentioned here. The first point concerns what the stuffing list looks like for the simulations. For each POD there is only one chapter of stuffing lists, where each list displays the consignees serviced by a breakbulk point, and there is one list for each breakbult point. In effect, single consignee vans are not conspicuously emphasized in the simulation runs. The stuffing list generation program was modified for this purpose. The modified program is depicted in Computer Program One.

The second point is concerned with the breakeven point. The breakeven point was set at fifty percent of a container's volume for all PODs.

The third point is the availability of containers for booking and stuffing. All containers needed for booking or stuffing were made available to the stuffing station.

Finally, there were no variations in days between lift. For example, when average days between lifts was set at seven

days, vessels arrived every seven days without variation. In practice, the average days between lift is an uncontrollable parameter from a managerial viewpoint, but it is controllable in the simulation model.

III. PROCEDURES OF ANALYSIS

A. DATA PREPARATION AND SIMULATION ASSUMPTIONS

The raw shipment data used for this thesis were taken from east coast and west coast military container stuffing stations. These two sets of data were used in the simulation phase. The first set was taken from computer tapes supplied by MOTBA for the 180 day operation period from 1 July 1973 to 31 December 1973 . This data contained information on 47,519 shipments received at MOTBA's Container Stuffing Station during the period under consideration.

The second set was taken from computer tapes supplied by MOTBY for the three month operation period from 1 October 1973 to 31 December 1973. This data contained information on 45,562 shipments received at the east area Container Stuffing Station.

The simulation model was used to simulate operations at each container stuffing station. The first group of runs consisted of thirteen major PODs served by the west coast station. The second group of runs consisted of eighteen major PODs served by the east coast station. In each group of runs, stuffing policies, average days between lift and container size, were varied in several ways to perturb the response variables. Stuffing policy variations consisted of varying breakeven adjustment factors four ways. Average days between lift were varied in three ways at the west area operation, in four ways at east area operation. The container

sizes were varied in two ways. It should be noted that each simulation run used only one container size. In all, this gave twenty-four combinations for the west coast station, and thirty-two combinations for the east coast station. The summary of simulation run variations are depicted in Figure 3.

The breakeven adjustment factors were set at (0.7), (1.0), (1.3) and (1.6). Average days between lift were set at seven days, 14 days, and 21 days on west area, at four days, seven days, 14 days and 21 days on east area operation.

Container sizes were set at the small 8x8x20 foot van with volumes in 1,120 cubic feet and weight capacities 40,000 pounds, and the large 8x8x40 foot van with volume in 2,390 cubic feet and weight capacities 46,000 pounds respectively.

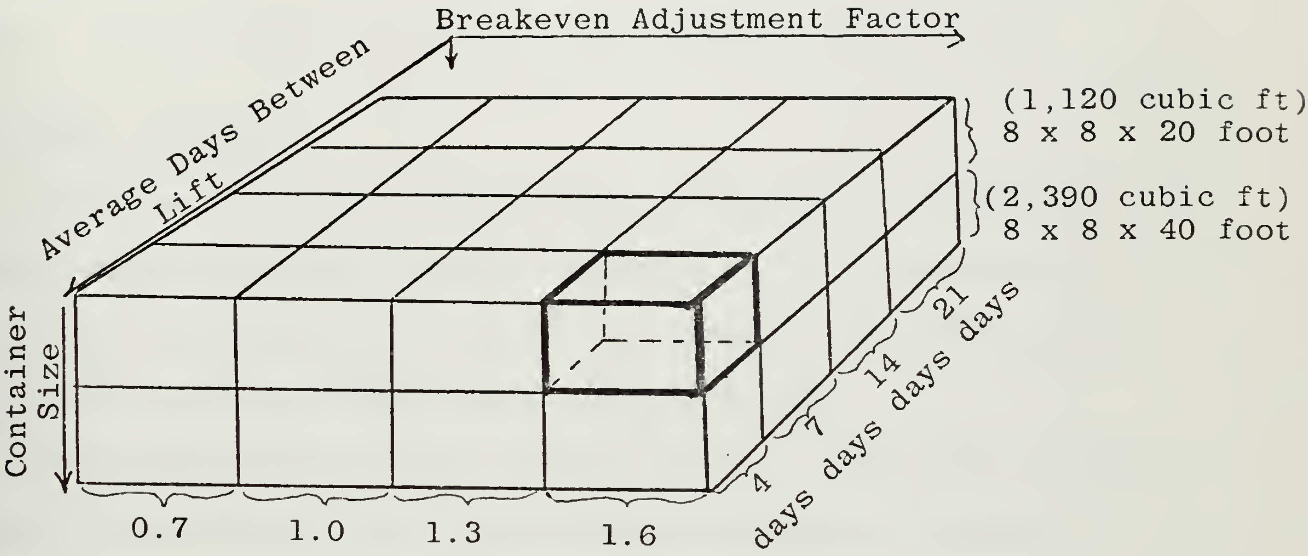
The simulated period on each simulation run was 360 days, a one year span.

The operational statistics (response variables) produced by each simulation for the consignees at each POD are:

1. Minimum shipment delay.
2. Average shipment delay (t)
3. Maximum shipment delay
4. Standard deviation of shipment delay
5. Average Container Utilization (u)
6. Single Consignee Proportion (v)
7. Single Consignee Shipment Proportion (s)

In order to obtain a usable format of data for the analysis phase, the POD operations summary Selection Program [Ref. 7

The Set of Simulation Run



Dimension 1 :	Average Days Between Lift	east	(4 ways)
		west	(3 ways)
Dimension 2 :	Breakeven Adjustment Factor		(4 ways)
Dimension 3:	Container Size		(2 ways)

This produces twenty-four combinations for the west coast station which serves 13 PODs, and 32 combinations for the east coast station which serves 18 PODs.

Figure 3

SIMCON] was modified. The parameters and the response variables of each simulation run were punched out on the same card. The program is described in Computer Program Two.

B. DATA ANALYSIS

Two phases of data analysis were conducted. The first phase of this analysis was the examination of the ranges in the response variables. All of the response variable ranges for given operating parameters are identified.

The second phase of data analysis was a sensitivity analysis. The objective was to identify relationships between response variable and parameters. Simulation outputs were analyzed through a series of stepwise linear regressions using the BMD02R statistical package to establish the mathematical relationships among the variables and to determine the degree of correlation among them.

To facilitate the analyses, and condense results, the PODs were divided into five groups. The categories are based on the volume of weekly shipments going to each POD. The list of examined PODs and the group categories of the PODs are described in Table I and II.

IV. RANGE OF RESPONSE VARIABLES

This chapter presents the resulting response variable "ranges" for given operations parameters and simulation assumptions.

Totally, 56 sets of simulation runs were executed for each POD. As for the results, the following two facts should be noted. Firstly, simulation output was deleted for POD 2 at the east coast station because shipment input volumes were much too small during the simulated period. Similarly, the results for Group IV PODs tend to be erratic because of their low volume. Secondly, the single consignee proportion is always one hundred percent at most of the eastern PODs. This is because the consignees are such that no two share the same breakbulk station. The only PODs where shipments can be mixed at the east coast station are POD 1, POD 4, POD 9, POD 11, and POD 13.

Complete computer outputs are in the custody of Professor James P. Hynes at the Naval Postgraduate School, Monterey, California 93940. The summarization of simulation outputs are enclosed in Tables III, IV, V, VI, VII, IX, XI, and XIII. The ranges of each response variable are discussed below.

A. THE RANGES OF SHIPMENT DELAY

The ranges of the minimum shipment delay, the maximum shipment delay and the average shipment delay were examined here.

1. The minimum shipment delay.

The minimum shipment delay was one day in every POD's performance for all operations parameters.

2. The maximum shipment delay.

The ranges of maximum shipment delay are shown in Table VII. In practice, these long delays would not exist because they are checked by station managers on a weekly or monthly base.

A closer look at the results show that the maximum shipment delays were relatively increased by changing the operations parameters from low (e.g., ADBL: 7 days, BAF: 0.7, Container size 20) to high (e.g., ADBL: 21 days, BAF: 1.6, Container size 40). Relatively speaking, the change of the breakeven adjustment factor appear to have the greatest impact on large PODs, and the change of container size appears to have significant impact on smaller PODs. For example:

POD GROUP I

POD	W-POD 1	E-POD 1
ADBL	14 days	14 days
Container Size	2390 c/f	2390 c/f
BAF: Max delay	1.0 80 days	1.0 101 days
	1.3 129 days	1.3 224 days
	1.6 255 days	1.6 225 days

POD GROUP II

POD	W-POD 3	E-POD 3
ADBL	14 days	14 days
BAF	1.3	1.3

Container Size: Max delay

1120 c/f	98 days	1120 c/f	151 days
2390 c/f	311 days	2390 c/f	361 days

Finally, it should be noted that the range of maximum shipment delay is widespread, and no strong consistent inter-relationships appear to exist.

3. Average shipment delay

Examination of the outputs shown in Table IV reveal several interesting facts. First, the range of the average shipment delay is very close for POD Groups I to IV. The range is around four days on the low side, and around 20 days on the high side. (However, W-3, E-6, E-12, E-10, and E-4 are exceptions to this.) Notice that the high value is roughly equal to the average days between lift and the low value is roughly half the average days between lift. Second, the ranges of the average shipment delay increase when the POD size decreases. Third, the ranges increase when ADBL, BAF, and container size increase.

B. THE RANGES OF AVERAGE CONTAINER UTILIZATION

A look at Table V shows that utilization falls between 54.44 percent on the low side and 88.95 percent on the high side. For the majority of PODs, utilization is approximately between 70 percent to 86 percent. The highest response value is around 86 percent for any operations parameter. Also, the results indicate that utilization is generally low for large container sizes, small ADBL and BAF. High utilization values

are obtained by using small container sizes, longer ADBL, and large breakeven adjustment factors. The results are shown in Table XI. Other interesting facts are presented in the table below:

POD GROUP	THE RANGE (%)		WIDTH OF RANGE (%)
I	77.56	85.43	7.87
II west	74.83	85.12	10.29
east	78.87	86.25	7.38
III west	71.00	85.20	14.20
east	70.39	85.71	15.32
IV west	61.90	85.96	24.06
east	61.49	85.18	23.69
V west	54.55	86.83	32.28
east	62.48	87.66	25.18

The lower side is clearly decreased as POD size decreases. However, the high side is not significantly effected.

C. THE RANGE OF SINGLE CONSIGNEE PROPORTION

As mentioned in the beginning of this chapter, only five POD data are available in this category. The results are presented in Table VI. The range is fairly wide over all PODs. However, the performance of the eastern PODs is higher than the western PODs; this is due to the fact that the western PODs typically allow greater mixing of cargo than eastern PODs.

In general, one can conclude that container size and the average days between life are significant factors affecting

single consignee proportion. The breakeven adjustment factor is not as important.

D. THE RANGE OF SINGLE CONSIGNEE SHIPMENT PROPORTION

The results are presented in Table VII. It shows that the range of single consignee is widely distributed. However, the range decreases when POD volume becomes amaller. The results here are analagous to the single consignee proportion results.

V. THE SENSITIVITY OF RESPONSE VARIABLES

The BIMED02R Computer Package [Ref. 9] with its stepwise regression program was used to measure the interrelationships among the three operations parameters (independent variables) and each response variable (dependent variables).

BIMED02R produces a stepwise linear fit for the variables specified and prints the results out in tabular form with coefficients for each of the independent variables and the related calculations for each step in the regression.

The multiple correlation coefficient of the regression (MR), with the standard error of estimate (STD-EST), the standard errors of the regression coefficients and F values are displayed for each step of the regression.

As before, the western PODs and the 18 eastern PODs are divided in five groups. The approach used here was to fit equations to each set of observations. Then, equations were fitted for each POD group.

The equations describe the general sensitivity of response variables to operations parameters.

The following general equations were examined in this phase:

$t = f_1$ (ADBL, Minimum Load Requirement, Container Volume)

$u = f_2$ (ADBL, Minimum Load Requirement, Container Volume)

$v = f_3$ (ADBL, Minimum Load Requirement, Container Volume)

by POD and POD groups.

In order to obtain more interpretable equations, the minimum load requirement was used instead of the breakeven adjustment factor. The minimum load requirement is obtained by multiplying the minimum load requirement proportion (P) by the container volume (C). The value of (P) is (.5) times the Breakeven Adjustment Factor (BAF). The value of (C) is 1,120 cubic feet or 2,390 cubic feet for small and large containers respectively.

The following steps were used for defining each response variable's equation. The first step was to hypothesize an equation. The second step was to evaluate the significance of the regression coefficients. Next, various modifications were tried in an effort to create the best fit. The final step was to determine the best fit equation for each POD group.

A. THE SENSITIVITY OF AVERAGE SHIPMENT IN DELAY

The following equation was first hypothesized.

$$t = a_0 + a_1 \,(ADBL) + a_2(ADBL)^2 + a_3(C) + a_4(P \times C) + a_5 \frac{(P \times C)}{ADBL}$$

It was hypothesized that ADBL would have a curvilinear affect on t, and that the effect of (P x C) on t would decrease as ADBL increased. Neither of these hypotheses were substantiated in the regression results.

New next equation was as follows:

$$t = a_0 + a_1(ADBL) + a_2(C) + a_3(P \times C).$$

The regression results gave multiple correlation coefficients ranging from (0.5752) to (0.9997), and the clear majority were above (0.9900). For all western PODs, R was higher than (0.9680).

ADBL and (P X C) were very important for all PODs; however, the F value for C was relatively small compared to other factors. The regression coefficients for C were not significantly different from zero.

The final regression equation was:

$$t = a_0 + a_1 \text{ (ADBL)} + a_2 (P \times C)$$

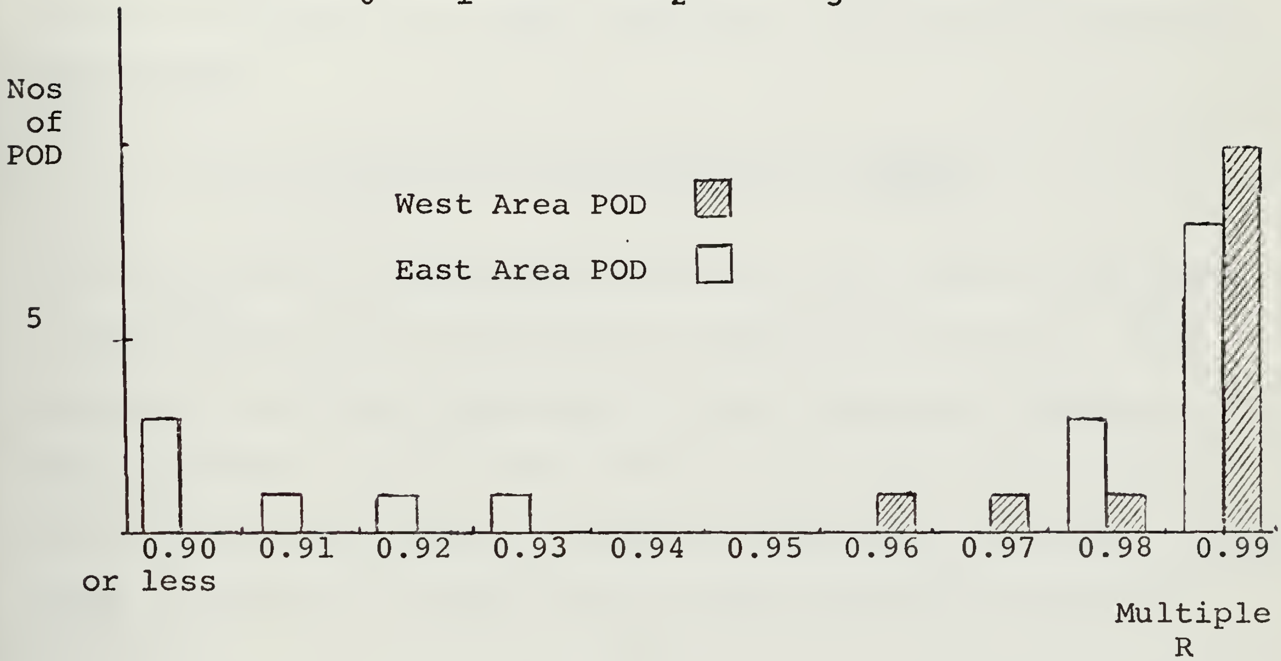
All of the regression coefficients were significantly different from zero. Final regression output is presented in Table VIII. Multiple R ranged from (0.7824) to (0.9990), but the clear majority still above (0.9800). This range is negligibly lower than the previous equation. The distribution of multiple R of both equations are shown in Figure 4.

An examination of the regression equation reveals several interesting facts. First, the average shipment in delay (t) is principally dependent upon two variables: the average days between lift and the minimum load requirement. A closer look at the F values reveals that average days between lift has a more distinct impact on the larger volume POD groups I, II and III.

Im summary, the group POD regression equations are presented in Tables IX and X.

THE DISTRIBUTION OF MULTIPLE R

$$t = a_0 + a_1(ADBL) + a_2(C) + a_3(P \times C)$$



$$t = a_0 + a_1(ADBL) + a_2(P \times C)$$

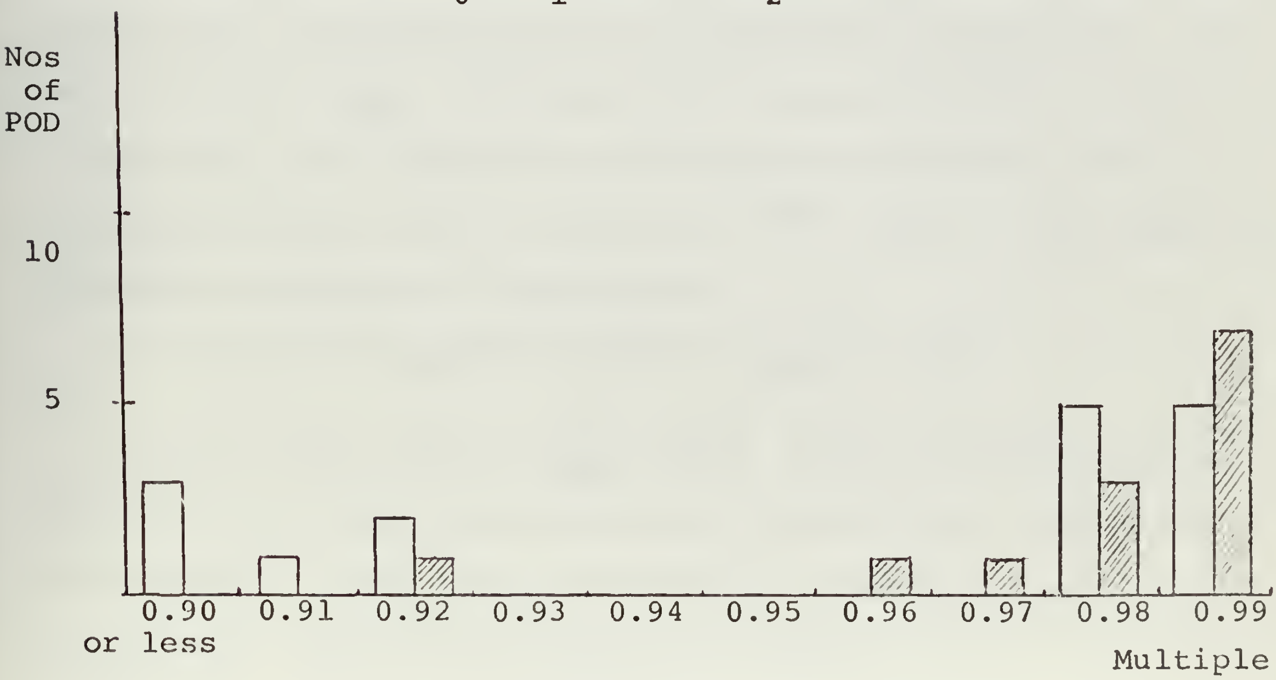


FIGURE 4

B. THE SENSITIVITY OF THE AVERAGE CONTAINER UTILIZATION (u)

It was initially hypothesized that all variables would have some effect on u, and, therefore, the following equation was tested.

$$u = b_0+b_1(ADBL)+b_2(P)+b_3(C)+b_4(PxC)+b_5\left(\frac{PxC}{ADBL}\right)$$

Of the thirty POD regression results, the F value of variable P and $\frac{PxC}{A}$ were not significantly different from zero. Only container size was significant in the estimation equation. The regression coefficients were not significantly different than zero in all factors. However, multiple correlation ranged from (0.9120) to (0.9969) and the clear majority were above (0.970).

The other transformations were attempted with the data in an effort to find a better fit. The square root of P and several other transformations were introduced to regression. It was found that $\frac{1}{ADBL}$ (the inverse of the average days between lift) and $\frac{1}{C}$ (the inverse of the container size) had some significance, along with the variables $\sqrt{P}$ and P^2. The modified estimation equation is shown below:

$$u = b_0+b_1(P^2)+b_2(\sqrt{P})+b_3(PxC)+b_4\left(\frac{1}{ADBL}\right)+b_5\left(\frac{1}{C}\right)$$

It was found that the $\frac{1}{ADBL}$ and $\frac{1}{C}$ factors became significant, but the other three did not. The multiple correlation was slightly higher than the original estimation; the multiple correlation ranged from (0.932) to (0.997).

The last step of the regression analysis was executed with the following equation:

$$u = b_0+b_1(\sqrt{P})+b_2(\frac{1}{ADBL})+b_3(\frac{1}{C})$$

The results of regression are shown in Table XXII. The regression coefficients of all the variables became significantly different than zero.

The variable $\frac{1}{C}$ appeared most important for the average container utilization in large volume PODs. In contrast, the variable $\sqrt{P}$ appeared most important in the small volume of PODs.

A comparison was made between the regression equations for the western area and the regression equations for the eastern area. This information is shown in Table XI. The regression equations for POD groups are presented in Tables XII and XIII.

Initially, the following equation was used:

$$v = C_0 + C_1(ADBL) + C_2(C) + C_3(P \times C) + C_4(\frac{PxC}{ADBL})$$

Average days between lifts and container size were clearly significant in the regression results, other factors were not. The multiple correlation ranged from (0.9538) to (0.9963), with the clear majority above (0.990). For the same reason as in previous section, the inverse of the average days between lift and the container size were introduced to the equation.

The final equation is shown below:

$$v = C_0 + C_1(\frac{1}{ADBL}) + C_2(\frac{1}{C})$$

The results of the final regression analysis are presented in Table XIV.

Each regression coefficient coefficient is significantly different from zero.

It appears that the average days between lift and container size are equally important factors for the single consignee proportion. The comparison of east-west regression equations are shown in Table XXVI, and POD group equations are shown in Tables XV and XVI.

IV. CONCLUSIONS

This thesis concerns itself with the characteristics of a container stuffing simulation model of a Department of Defense containerized export cargo transportation system. The shipment data used in this work was taken from actual operations at the container stuffing station, MOTBA and MOTBY, for a six-month period and three-month period of 1973, respectively.

Data analysis techniques were utilized to identify the ranges of response variables given operations parameters and the simulation assumptions, and to identify the sensitivity of response variable to changes in parameters.

Fifty-six simulation runs for each of the 31 PODs were executed using the container stuffing station simulation model. Thirteen major PODs served by the west coast station and eighteen PODs served by the east coast station were involved.

The data generated by the simulations were analyzed in two ways. First, ranges of response variables were examined. Second, data was analyzed through regression analysis techniques. This revealed some of the operationals characteristics of the model, particularly with regard to the sensitivity of response variables to changes in parameters.

The results of the regression analyses strongly suggest that:

1. The average shipment delay is principally dependent upon two variables, the average days between lift and the minimum load requirement;

2. The single consignee proportion is principally dependent upon the average days between lift and the container size;

3. The average container utilization is dependent upon three variables, the minimum load requirement proportion, the average days between lift, and container size. These results particularly the regression equations, can be utilized for planning purposes.

WESTERN PODS

POD No.	POD LOCATION	POD CODE	NO. OF CONSIGNEES SERVED	TOTAL ** SHIPMENT	TOTAL VOLUME *	WEEKLY VOLUME FORECAST *	WEEKLY ** SHIPMENT FORECAST
1	Thailand	RA3	58	9,384	749,900	28,850	360
2	Taiwan	RJ1	29	1,274	75,321	2,900	50
3	Taiwan	RJ3	19	1,128	54,657	2,100	43
4	Philippines	SA1	41	8,275	586,328	22,500	320
5	Guam	TA2	29	3,171	259,255	10,000	120
6	Okinawa	UB1	79	6,230	570,502	21,000	240
7	Korea	UC2	46	4,208	492,920	19,000	160
8	Korea	UD6	30	1,232	66,642	2,180	47
9	Iwakuni	UL7	19	1,402	96,653	3,720	53
10	Yokohama	UM1	41	2,930	160,413	5,400	110
11	Yokosuka	UM7	30	1,625	135,360	5,200	62
12	Sasebo	UQ2	4	334	22,181	850	12
13	Hawaii	XE2	131	6,326	668,719	25,600	240

* Cubic Feet

** Number of Shipments

TABLE I-(1). POD LIST (WEST)

EASTERN PODS

POD NO.	POD LOCATION	POD CODE	NO. OF CONSIGNEES SERVED	TOTAL ** SHIPMENT	TOTAL VOLUME *	WEEKLY VOLUME FORECAST *	WEEKLY SHIPMENT FORECAST **
1	Canal Zone (Balboa)	BA1	22	3,084	367,358	28,258	240
2	Bermuda (St. George)	CA2	1	6	6	1	1
3	Guantanamo	CE1	5	199	45,378	3,500	15
4	Puerto Rico (San Juan)	CK1	20	323	25,446	2,000	24
5	United Kingdom (London)	HA7	11	3,064	330,035	25,000	235
6	United Kingdom (Felixstone)	HA8	29	1,938	335,214	26,000	150
7	Liverpool	HB4	6	51	4,151	320	4
8		HED	2	8	9,808	750	1
9	Germany	JF1	44	10,627	3,089,466	238,000	817
10	(Bremerhaven)						
10	Netherlands	JG1	31	1,177	121,714	9,000	9
11	Belgium (Antwerp)	JH2	296	3,465	919,551	71,000	266
12	Italy (Naples)	KF1	11	508	122,559	9,400	40
13	Italy (Leghorn)	KF3	23	1,204	257,305	20,000	92
14	Spain (Cadiz)	KJ1	16	1,070	157,604	12,000	82
15	Spain (Rota)	KJ2	9	729	153,617	12,000	56
16	Greece (Piraeus)	LD1	11	2,570	218,014	18,000	197
17	Turkey	LR1	10	6,207	514,005	40,000	477
18	Turkey (Istanbul)	LR2	25	3,993	184,124	14,000	307

* Cubic Feet

** Number of Shipments

TABLE I-(2). POD LIST (EAST)

WEST AREA PODS				EAST AREA PODS			
POD GROUP	POD NO	WEEKLY SHIPMENT FORECAST **	WEEKLY VOLUME * FORECAST	WEEKLY VOLUME * FORECAST	WEEKLY SHIPMENT FORECAST **	POD NO.	POD GROUP
				238,000	817	9	
I				71,000	266	11	I
				40,000	477	17	
	1	360	28,850	28,258	240	1	
	13	240	25,600	26,000	150	6	
II				25,000	235	5	II
	4	320	22,500	20,000	92	13	
	6	240	21,000	18,000	197	16	
	7	160	19,000				
	5	120	10,000	14,000	307	18	
	10	110	5,400	12,000	82	14	
III	11	62	5,200	12,000	56	15	III
				9,400	40	12	
				9,000	9	10	
	9	53	3,720	3,500	15	3	
	2	50	2,900	2,000	24	4	
IV	8	47	2,180				IV
	3	43	2,100				
	12	12	850	750	1	8	
V				320	4	7	V
				1	1	2	

*Cubic Feet
**Number of Shipment

TABLE II. POD GROUP CATEGORIES.

POD GROUP / POD		RESPONSE VARIABLE MAXIMUM SHIPMENT DELAY									RESPONSE VARIABLE MAXIMUM SHIPMENT DELAY							
		PARAMETERS FOR LOW R			RANGE (DAYS)		PARAMETERS FOR HIGH R				PARAMETERS FOR LOW R			RANGE (DAYS)		PARAMETERS FOR LOW R		
POD GROUP	POD	ADBL	BAF	C	LOW	HIGH	ADBL	BAF	C	POD	ADBL	BAF	C	LOW	HIGH	ADBL	BAF	C
I										E-9	21	1.6	L	196	352	14	1.6	L
I										E-11	7	0.7	L	242	364	21	0.7	S
I										E-17	21	1.0	S	149	304	21	0.7	S
II	W-1	21	0.7	S	63	255	21	1.6	L	E-1	7	1.0	L	44	351	21	1.6	L
II	W-13	7	0.7	S	82	319	14	1.6	L	E-6	7	1.0	S	209	342	21	1.6	L
II										E-5	7	1.0	L	96	298	21	1.6	L
II	W-4	21	0.7	S	120	246	21	1.0	L	E13	14	1.0	L	155	344	14	0.7	L
II	W-6	7	0.7	S	47	304	21	1.6	L	E16	21	1.3	L	83	359	21	0.7	L
II	W-7	7	0.7	S	40	333	7	1.6	L									
III	W-5	7	0.7	S	82	220	21	1.6	L	E18	7	1.0	S	135	356	21	0.7	S
III	W-10	7	1.0	S	100	274	21	1.6	L	E14	7	1.0	L	135	296	21	1.6	S
III	W-11	7	1.6	L	137	301	21	1.3	S	E15	7	0.7	S	156	343	21	1.0	L
III										E12	21	1.3	S	129	339	21	1.6	L
III										E10	7	0.7	S	221	340	21	1.0	L
IV	W-9	7	0.7	S	30	152	14	1.6	L	E-3	7	0.7	S	102	361	21	1.3	L
IV	W-2	14	1.0	S	56	142	21	1.6	S	E-4	7	0.7	S	175	322	21	1.3	S
IV	W-8	7	0.7	L	28	181	14	1.6	S									
IV	W-3	7	0.7	S	74	329	21	1.6	L									
V	W-12	77	0.7	S	101	242	14	1.6	L	E-8	7	0.7	L	23	106	7	0.7	L
										E-7	7	1.6	S	70	341	21	1.3	S
NOTE:	S denotes small containers (1,120 cubic feet).																	
	L denotes large containers (2,390 cubic feet).																	

TABLE III. SUMMARY OF THE RANGES (MAXIMUM SHIPMENT DELAY).

POD GROUP	POD	RESPONSE VARIABLE AVERAGE SHIPMENT DELAY: PARAMETERS FOR LOW R			RANGE (DAYS)		PARAMETERS FOR HIGH R			POD	RESPONSE VARIABLE AVERAGE SHIPMENT DELAY: PARAMETERS FOR LOW R			RANGE (DAYS)		PARAMETERS FOR LOW R		
		ADBL	BAF	C	LOW	HIGH	ADBL	BAF	C	POD	ADBL	BAF	C	LOW	HIGH	ADBL	BAF	C
I										E-9	7	0.7	S	4.78	13.03	21	1.6	L
I										E11	7	0.7	S	6.18	16.08	21	1.6	L
I										E17	7	1.0	S	4.58	12.06	21	1.6	L
II	W-1	7	0.7	S	5.07	15.23	21	1.6	L	E-1	7	0.7	S	4.51	12.72	21	1.6	L
II	W13	7	0.7	S	5.35	14.98	21	1.6	L	E-6	7	0.7	S	11.46	25.14	21	1.3	L
II										E-5	7	0.7	S	4.39	11.72	21	1.6	S
II	W-4	7	0.7	S	4.49	13.01	21	1.6	L	E13	7	0.7	S	6.96	16.65	21	1.6	L
II	W-6	7	0.7	S	4.20	14.14	21	1.6	L	E16	7	0.7	S	4.85	12.42	21	1.6	L
III	W-7	7	0.7	S	3.54	13.03	21	1.6	L									
III	W-5	7	0.7	S	4.25	13.61	21	1.6	L	E18	7	0.7	S	6.47	15.78	21	1.6	L
III	W10	7	0.7	S	4.95	12.11	21	1.6	L	E14	7	0.7	S	7.56	22.89	21	1.6	L
III	W11	7	0.7	S	5.61	20.51	21	1.6	L	E15	7	0.7	S	7.37	19.27	21	1.6	L
III										E12	7	0.7	S	9.85	25.02	21	1.6	L
III										E10	7	0.7	S	10.44	35.28	21	1.6	L
IV	W-9	7	0.7	S	5.02	16.33	21	1.6	L	E-3	7	0.7	S	8.82	18.23	21	1.6	L
IV	W-2	7	0.7	S	6.67	22.03	21	1.6	L	E-4	7	0.7	S	16.46	43.55	21	1.6	L
IV	W-8	7	0.7	S	5.32	12.74	21	1.6	L									
IV	W-3	7	0.7	S	6.23	82.25	21	1.6	L									
V	W-12	7	0.7	S	7.41	34.51	21	1.6	L	E-8	7	1.0	L	6.86	30.82	21	1.6	L
V										E-7	7	0.7	L	11.93	52.98	21	1.6	L
V																		

TABLE IV. SUMMARY OF RANGE (AVERAGE SHIPMENT DELAY).

POD GROUP	POD	RESPONSE VARIABLE AVERAGE CONTAINER UTILIZATION								POD	RESPONSE VARIABLE AVERAGE CONTAINER UTILIZATION							
		PARAMETERS FOR LOW R			RANGE PERCENTS		PARAMETERS FOR HIGH R				PARAMETERS FOR LOW R			RANGE PERCENTS		PARAMETERS FOR LOW R		
		ADBL	BAF	C	LOW	HIGH	ADBL	BAF	C		ADBL	BAF	C	LOW	HIGH	ADBL	BAF	C
I										E-9	7	0.7	L	82.72	86.09	21	1.6	S
I										E11	7	0.7	L	72.80	84.95	21	1.6	S
I										E17	7	0.7	L	77.17	85.25	14	1.6	S
II	W-1	7	0.7	L	68.46	84.10	14	1.6	S	E-1	7	0.7	L	81.56	85.87	7	1.6	S
II	W-13	7	0.7	L	78.95	86.68	21	1.6	S	E-6	7	0.7	L	70.95	86.01	21	1.6	S
II										E-5	7	0.7	L	86.00	88.00	21	1.6	S
II	W-4	7	0.7	L	79.56	85.80	21	1.6	S	E13	7	0.7	L	72.39	86.38	14	1.6	S
II	W-6	7	0.7	L	72.35	83.91	21	1.6	L	E16	7	0.7	L	78.45	85.01	14	1.6	S
III	W-7	7	0.7	L	69.14	82.90	21	1.6	S									
III	W-5	7	0.7	L	73.84	85.98	14	1.6	S	E18	7	0.7	L	68.02	87.13	21	1.6	S
III	W-10	7	0.7	L	64.99	84.97	21	1.6	S	E14	7	0.7	L	72.27	85.31	21	1.6	S
III	W-11	7	0.7	L	76.06	86.96	21	1.6	S	E15	7	0.7	L	75.28	85.13	7	1.6	S
III										E12	7	0.7	L	73.57	85.18	7	1.6	S
III										E10	7	0.7	L	62.83	85.82	21	1.6	S
IV	W-9	7	0.7	L	67.26	85.55	21	1.6	S	E-3	7	0.7	L	66.01	84.64	21	1.6	S
IV	W-2	7	0.7	L	59.63	85.52	21	1.6	S	E-4	7	0.7	L	56.98	85.72	14	1.6	S
IV	W-8	7	0.7	L	59.70	86.45	21	1.6	S									
IV	W-3	7	0.7	L	61.02	86.35	21	1.6	S									
V	W-12	7	0.7	L	54.55	86.83	14	1.6	S	8	7	0.7	L	69.81	88.95	14	1.6	L
V										7	7	0.7	L	55.16	86.37	21	1.6	L

TABLE V. SUMMARY OF RANGE (AVERAGE CONTAINER UTILIZATION).

POD GROUP	POD	RESPONSE VARIABLE SINGLE CONSIGNEE PROPORTION									RESPONSE VARIABLE SINGLE CONSIGNEE PROPORTION								
		PARAMETERS FOR LOW R			RANGE PERCENTS		PARAMETERS FOR HIGH R				PARAMETERS FOR LOW R			RANGE PERCENTS		PARAMETERS FOR LOW R		
		ADBL	BAF	C	LOW	HIGH	ADBL	BAF	C	POD	ADBL	BAF	C	LOW	HIGH	ADBL	BAF	C
I										E-9	7	0.7	L	99.51	99.79	21	1.0	S
I										E11	7	0.7	L	57.38	81.09	21	1.6	S
II	W-1	7	0.7	L	63.80	83.44	21	1.6	S	E-1	7	0.7	L	85.67	94.96	21	1.6	S
II	W-13	7	1.0	L	59.97	82.53	21	1.6	S									
II	W-4	7	0.7	L	59.04	87.47	21	1.6	S	E13	7	0.7	L		95.43	21	1.6	S
II	W-6	7	0.7	L	69.30	86.16	21	1.3	S									
III	W-7	7	0.7	L	85.41	90.66	21	1.6	S									
III	W-5	7	1.0	L	43.40	81.38	21	1.6	S									
III	W-10	7	1.3	L	44.93	71.92	21	1.6	S									
III	W-11	7	0.7	L	61.95	81.13	21	1.6	S									
IV	W-9	7	0.7	L	57.72	78.42	21	1.6	S									
IV	W-2	7	1.6	L	18.11	52.39	21	1.6	S	E-4	7	1.6	L	62.12	78.55	21	1.0	S
IV	W-8	7	1.6	L	4.81	36.94	21	1.6	S									
IV	W-3	7	0.7	L	15.87	48.93	21	1.3	S									
V	W-12	7	0.7	L	30.66	64.80	21	1.0	S									

TABLE VI. SUMMARY OF RANGE (SINGLE CONSIGNEE PROPORATION).

POD GROUP	POD	THE RESPONSE VARIABLE SINGLE CONSIGNEE SHIPMENT PROPORTION								POD	THE RESPONSE VARIABLE SINGLE CONSIGNEE SHIPMENT PROPORTION							
		PARAMETERS FOR LOW R			RANGE PERCENTS		PARAMETERS FOR HIGH R				PARAMETERS FOR LOW R			RANGE PERCENTS		PARAMETERS FOR LOW R		
		ADBL	BAF	C	LOW	HIGH	ADBL	BAF	C		ADBL	BAF	C	LOW	HIGH	ADBL	BAF	C
I										E-9	7	0.7	L	99.44	99.67	21	1.6	S
I										E11	7	1.3	L	26.37	43.23	21	0.7	S
II	W-1	7	0.7	L	41.13	70.17	21	1.6	S	E-1	7	1.0	L	84.74	92.51	21	1.6	S
II	W-13	7	1.3	L	34.07	59.55	21	0.7	S									
II	W-4	7	0.7	L	50.18	76.38	21	1.6	S	E13	7	1.6	L	90.39	94.50	21	1.3	S
II	W-6	7	0.7	L	54.08	76.30	21	1.6	S									
III	W-7	7	1.0	L	66.66	77.96	21	1.6	S									
III	W-5	7	1.3	L	29.11	68.94	21	1.6	S									
III	W-10	7	1.3	L	36.41	55.75	21	1.6	S									
III	W-11	7	0.7	L	45.63	60.97	21	1.3	S									
IV	W-9	7	1.3	L	48.14	67.32	21	1.6	S									
IV	W-2	7	1.0	L	12.44	32.66	21	1.6	S	E-4	14	1.6	L	33.17	56.75	21	1.3	S
IV	W-8	7	1.6	L	0.60	30.30	21	1.3	S									
IV	W-3	14	0.7	L	1.67	41.22	21	1.0	S									
V	W-12	7	0.7	L	22.52	50.39	14	0.7	S									

TABLE VII. SUMMARY OF RANGE (SINGLE CONSIGNEE SHIPMENT PROPORTION).

EQUATION: $t = a_0 + a_1(\text{ADBL}) + a_2(P \times C)$

POD	MULTIPLE R	STANDARD ERROR ESTIMATE	a_0 INTERCEPT	a_1 ADBL	a_2 (P X C)	POD GROUP
W-1	0.9940	0.3375	0.95097	0.46813 (1508.2)	0.00211 (216.3)	
W-13	0.9951	0.3112	1.20011	0.40738 (1974.4)	0.00167 (160.3)	
W-4	0.9977	0.2138	0.79281	0.51022 (4402.1)	0.00080 (77.4)	II
W-6	0.9963	0.2632	0.07899	0.46830 (2481.4)	0.00199 (317.01)	
W-7	0.9965	0.2657	-0.51702	0.49653 (2715.0)	0.00170 (227.6)	
W-5	0.9966	0.2421	0.48007	0.45122 (2715.0)	0.00188 (334.0)	
W-10	0.9894	0.5010	0.56690	0.46227 (660.2)	0.00375 (310.7)	
W-11	0.9767	0.8195	0.53504	0.53254 (317.2)	0.00369 (112.4)	III
W-9	0.9923	0.4186	0.44716	0.51346 (1142.5)	0.00250 (197.8)	
W-2	0.9824	0.7641	1.78732	0.37041	0.00636	
W-8	0.9838	0.6223	0.26720	0.49325 (444.2)	0.00341 (166.4)	IV
W-3	0.9665	1.4911	-1.80148	0.54052 (77.7)	0.00883 (192.5)	
W-12	0.9280	2.5707	-2.22581	0.61206 (20.2)	0.00774 (32.0)	V

NOTE ( ) F value to enter.

TABLE VIII-(1). REGRESSION SUMMARY (t: Step 2) (1)

EQUATION: $t = a_0 + a_1(ADBL) + a_2(P \times C)$

POD	MULTIPLE R	STANDARD ERROR ESTIMATE	a_0 INTERCEPT	a_1 ADBL	a_2 P x C	POD GROUP
E-9	0.9990	0.1517	1.22806	0.49301 (14468.6)	0.00077 (189.7)	I
E-11	0.9892	0.5059	2.34857	0.48077 (1217.4)	0.00184 (97.9)	
E-17	0.9980	0.2106	1.02640	0.51172 (7096.6)	0.00037 (23.2)	
E-1	0.9993	0.1251	0.72819	0.50372 (22007.3)	0.00066 (208.4)	II
E-6	0.9180	1.5845	8.29347	0.41227 (91.5)	0.00464 (63.5)	
E-5	0.9976	0.2288	1.19864	0.48310 (5988.3)	0.00016 (3.5)	
E-13	0.9844	0.5896	3.30816	0.46588 (853.8)	0.00155 (51.3)	
E-16	0.9968	0.2725	1.54897	0.49578 (4553.3)	0.00009 (0.8)	
E-18	0.9901	0.4763	1.95059	0.48574 (1236.3)	0.00243 (195.4)	III
E-14	0.9870	0.6731	2.87300	0.45084 (607.0	0.00545 (484.8)	
E-15	0.9833	0.6287	3.61704	0.43798 (655.9)	0.00318 (189.0)	
E-12	0.9230	1.6180	4.31188	0.44242 (100.9)	0.00482 (65.7)	
E-10	0.9885	1.0477	4.19454	0.39510 (185.0)	0.01245 (1044.4)	
E-3	0.7824	3.1119	4.38969	0.51664 (32.6)	0.00395 (11.9)	IV
E-4	0.9219	2.8788	11.01924	0.39719 (17.7)	0.01220 (130.5)	
E-8	0.4902	6.9317	0.61542	0.74157 (3.5)	0.00301 (1.0)	V
E-7	0.3268	9.8692	37.62675	-0.37975 (1.7)	0.00238 (0.1)	

Note ( ): F values to enter

LE VIII-(2) REGRESSION SUMMARY (t: step 2) (2)

$\underline{t = f_1 \text{ (ADBL, MINIMUM LOAD REQUIREMENT, CONTAINER VOLUME)}}$

Step 1		$t = a_0 + a_1 \text{(ADBL)} + a_2 \text{(C)} + a_3 \text{(P x C)}$
Step 2		$t = a_0 + a_1 \text{(ADBL)} + a_2 \text{(P x C)}$
Group I	East (OnlY)	$t_{1e} = 1.22806 + 0.49301\text{(ADBL)} + 0.00077\text{(P x C)}$
Group II	West	$t_{1w} = 1.19864 + 0.48310\text{(ADBL)} + 0.00016\text{(P x C)}$
	East	$t_{1e} = 0.95097 + 0.46813\text{(ADBL)} + 0.00211\text{(P x C)}$
		$a_{0e} - a_{0w} = 0.24767 \quad a_{1e} - a_{1w} = 0.01487 \quad a_{2e} - a_{2w} = -0.00795$
Group III	West	$t_{1w} = 1.95059 + 0.48574\text{(ADBL)} + 0.00243\text{(P x C)}$
	East	$t_{1e} = 0.56690 + 0.46227\text{(ADBL)} + 0.00375\text{(P x C)}$
		$a_{0e} - a_{0w} = 1.38369, \ a_{1e} - a_{1w} = 0.02347, \ a_{2e} - a_{2w} = -0.00132$
Group IV	West	$t_{1w} = 11.81924 + 0.39719\text{(ADBL)} + 0.01220\text{(P x C)}$
	East	$t_{1e} = 0.44716 + 0.51346\text{(ADBL)} + 0.00250\text{(P x C)}$
		$a_{0e} - a_{0w} = 11.37208, \ a_{1e} - a_{1w} = 0.11627, \ a_{2e} - a_{2w} = -0.00970$
Group V	West (Only)	$t_{1w} = -2.22581 + 0.61206\text{(ADBL)} + 0.00774\text{(P x C)}$

TABLE IX. COMPARISON OF REGRESSION COEFFICIENTS (t)

$t = f_1$ (ADBL, MINIMUM LOAD REQUIREMENT, CONTAINER VOLUME)

POD GROUP I

$$t = \underset{(a_0)}{1.22806} + \underset{(a_1)}{0.49301}\,(\text{ADBL}) + \underset{(a_2)}{0.00077}\,(P \times C)$$

Standard error of a_1	0.00410
Standard error of a_2	0.00006
Standard error of estimate	0.1517
Multiple correlation	0.9978

POD GROUP II

$$t = \underset{(a_0)}{0.95097} + \underset{(a_1)}{0.46813}\,(\text{ADBL}) + \underset{(a_2)}{0.00211}\,(P \times C)$$

Standard error of a_1	0.01205
Standard error of a_2	0.00014
Standard error of estimate	0.3375
Multiple correlation	0.9951

POD GROUP III

$$t = \underset{(a_0)}{0.56690} + \underset{(a_1)}{0.46227}\,(\text{ADBL}) + \underset{(a_2)}{0.00375}\,(P \times C)$$

Standard error of a_1	0.01799
Standard error of a_2	0.00021
Standard error of estimate	0.5010
Multiple correlation	0.9894

TABLE X-(1). THE GROUP POD REGRESSION EQUATIONS (t)

POD GROUP IV

$$t = \underset{(a_0)}{0.44716} + \underset{(a_1)}{0.51346}\ (ADBL) + \underset{(a_2)}{0.00250}\ (P \times C)$$

Standard error of a_1	0.01519
Standard error of a_2	0.00018
Standard error of estimate	0.4186
Multiple correlation	0.9923

POD GROUP V

$$t = \underset{(a_0)}{-2.22581} + \underset{(a_1)}{0.61206}\ (ADBL) + \underset{(a_2)}{0.00774}\ (P \times C)$$

Standard error of a_1	0.13589
Standard error of a_2	0.00137
Standard error of estimate	2.5707
Multiple correlation	0.9280

TABLE X-(2). THE GROUP POD REGRESSION EQUATIONS (t)

EQUATION: $u = b_0 + b_1(\sqrt{P}) + b_2(\frac{1}{ADBL}) + b_3(\frac{1}{C})$							
POD	MULTIPLE R	STANDARD ERROR ESTIMATE	b_0 INTERCEPT	b_1 $\sqrt{P}$	b_2 $\frac{1}{ADBL}^2$	b_3 $\frac{1}{C}$	POD GROUP
W-1	0.9849	0.0092	0.58163	0.12111 (52.4)	-0.14882 (10.2)	192.46869 (585.1)	II
W-13	0.8949	0.0084	0.76277	0.10069 (44.2)	-0.14748 (11.8)	35.58257 (24.4)	II
							II
W-4	0.9573	0.0051	0.75165	0.08453 (85.1)	-0.09272 (12.8)	48.07239 (121.6)	II
W-6	0.9831	0.0066	0.64973	0.09889 (69.6)	-0.12740 (14.9)	125.16223 (492.9)	II
W-7	0.9967	0.0046	0.59254	0.06445 (61.0)	-0.09938 (18.6)	211.71910 (2909.1)	II
W-5	0.9157	0.0126	0.66877	0.16869 (54.6)	-0.17592 (7.5)	70.26149 (41.8)	III
W-10	0.9376	0.0196	0.50250	0.32850 (85.9)	-0.35314 (12.5)	115.22304 (46.7)	III
W-11	0.9302	0.0122	0.66337	0.23233 (111.6)	-0.18344 (8.0)	29.23167 (7.8)	III
							III
							III
W-9	0.9207	0.0179	0.60375	0.20911 (41.6)	-0.33149 (12.4)	117.15402 (57.7)	IV
W-2	0.9435	0.0254	0.38576	0.51628 (126.5)	-0.62725 (18.9)	95.82608 (18.9)	IV
W-8	0.9521	0.0220	0.45826	0.28383 (50.7)	-0.39682 (9.6)	221.49507 (136.0)	IV
W-3	0.9432	0.0227	0.43034	0.45192 (120.2)	-0.78856 (23.8)	121.04962 (36.9)	IV
W-12	0.9820	0.0174	0.31982	0.43354 (168.1)	-1.74909 (41.9)	296.58838 (272.2)	V
							V
							V

Note (   ): F values to enter

TABLE XI-(1). REGRESSION SUMMARY (u: Step 3) (1)

EQUATION: $u = b_0 + b_1(\sqrt{P}) + b_2(\frac{1}{ADBL}) + b_3(\frac{1}{C})$

POD	MULTIPLE R	STANDARD ERROR ESTIMATE	b_0 INTERCEPT	b_1 $\sqrt{P}$	b_2 $\frac{1}{ADBL}$	b_3 $\frac{1}{C}$	POD GROUP
E-9	0.9745	0.0025	0.79631	0.03918 (96.3)	-0.02382 (16.9)	38.74136 (415.7)	
E-11	0.9883	0.0072	0.61093	0.10541 (86.8)	-0.06022 (11.8)	176.82643 (1078.8)	I
E-17	0.9933	0.0037	0.70168	0.05462 (88.8)	-0.03714 (18.5)	121.88429 (1954.8)	
E-1	0.9515	0.0047	0.77517	0.05346 (53.5)	-0.04412 (14.7)	49.20828 (200.3)	
E-6	0.9645	0.0121	0.56558	0.22474 (141.5)	-0.11588 (16.5)	131.75421 (214.8)	
E-5	0.9241	0.0023	0.84145	0.03825 (109.3)	-0.02456 (18.7)	10.38929 (35.6)	II
E-13	0.9635	0.0073	0.68875	0.12997 (128.5)	0.06420 (12.9)	81.40297 (222.7)	
E-16	0.9621	0.0055	0.73813	0.06590 (59.1)	-0.04014 (9.5)	68.44075 (281.7)	
E-18	0.9814	0.0127	0.49407	0.22146 (123.9)	-0.14502 (22.3)	229.99783 (590.3)	
E-14	0.9789	0.0091	0.55522	0.23481 (272.7)	-0.12166 (28.9)	124.96106 (341.2)	III
E-15	0.9695	0.0077	0.66204	0.12629 (110.4)	-0.07548 (15.6)	101.24153 (313.4)	
E-12	0.9626	0.0098	0.61403	0.19311 (159.9)	-0.10624 (18.4)	96.55682 (176.6)	
E-10	0.9762	0.0153	0.34331	0.47389 (391.3)	-0.17992 (19.6)	143.68214 (158.8)	
E-3	0.9937	0.0083	0.46727	0.015582 (142.9)	-0.10169 (12.8)	280.6926 (2047.9)	IV
E-4	0.9817	0.0162	0.21676	0.54582 (459.5)	-0.33983 (16.5)	195.6792 (255.1)	
E-8	0.9234	0.0277	0.43074	0.45379 (101.7)	-0.91716 (4.1)	146.20567	
E-7	0.9549	0.0305	0.13070	0.82100 (160.0)	0.25741 (0.0)	-4.27283 (0.0)	V

Note ( ): F values to enter

TABLE XI-(2). REGRESSION SUMMARY (u: Step 3) (2)

$U = f_2$ (ADBL, MINIMUM LOAD REQUIREMENT, CONTAINER VOLUME)

Step 1 $U = b_0 + b_1(A) + b_2(P) + b_3(C) + b_4(P \times C) + b_5\left(\frac{P \times C}{ADBL}\right)$

Step 2 $U = b_0 + b_1(P^2) + b_2(\sqrt{P}) + b_3(P \times C) + b_4\left(\frac{1}{ADBL}\right) + b_5\left(\frac{1}{C}\right)$

Step 3 $U = b_0 + b_1(\sqrt{P}) + b_2\left(\frac{1}{ADBL}\right) + b_3\left(\frac{1}{C}\right)$

			b_0	b_1	b_2	b_3
Group I	East (Only)	$U_{1e}=$	0.76168	$+ 0.05462(\sqrt{P})$	$-0.03714\left(\frac{1}{ADBL}\right)$	$+121.88429\left(\frac{1}{C}\right)$
Group II	West	$U_{1w}=$	0.77517	$+ 0.05346(\sqrt{P})$	$-0.04412\left(\frac{1}{ADBL}\right)$	$+ 49.20828\left(\frac{1}{C}\right)$
	East	$U_{1e}=$	0.75165	$+ 0.08453(\sqrt{P})$	$-0.09272\left(\frac{1}{ADBL}\right)$	$+ 48.07239\left(\frac{1}{C}\right)$
			$b_{0e}-b_{0w}=0.02352$,	$b_{1e}-b_{1w}=-0.03107$,	$b_{2e}-b_{2w}=0.04860$,	$b_{3e}-b_{3w}=1.1359$
Group III	West	$U_{1w}=$	0.66204	$+ 0.12629(\sqrt{P})$	$-0.07548\left(\frac{1}{ADBL}\right)$	$+101.24153\left(\frac{1}{C}\right)$
	East	$U_{1e}=$	0.66877	$+ 0.16869(\sqrt{P})$	$-0.17592\left(\frac{1}{ADBL}\right)$	$+ 70.26149\left(\frac{1}{C}\right)$
			$b_{0e}-b_{0w}=-0.00673$,	$b_{1e}-b_{1w}= -0.04240$,	$b_{2e}-b_{2w}=0.10044$,	$b_{3e}-b_{3w}=30.98004$
Group IV	West	$U_{1w}=$	0.46727	$+ 0.15582(\sqrt{P})$	$-0.10169\left(\frac{1}{ADBL}\right)$	$+280.69263\left(\frac{1}{C}\right)$
	East	$U_{1e}=$	0.45826	$+ 0.28383(\sqrt{P})$	$-0.39682\left(\frac{1}{ADBL}\right)$	$+221.49507\left(\frac{1}{C}\right)$
			$b_{0e}-b_{0w}=0.00901$,	$b_{1e}-b_{1w}=0.12801$,	$b_{2e}-b_{2w}=0.29513$,	$b_{3e}-b_{3w}=59.197$
Group V	West	$U_{1w}=$	0.43074	$+ 0.45279(\sqrt{P})$	$-0.91716\left(\frac{1}{ADBL}\right)$	$+146.20567\left(\frac{1}{C}\right)$
	East	$U_{1e}=$	0.31982	$+ 0.43354(\sqrt{P})$	$-1.74909\left(\frac{1}{ADBL}\right)$	$+296.58839\left(\frac{1}{C}\right)$
			$b_{0e}-b_{0w}=0.11092$,	$b_{1e}-b_{1w}=0.01925$,	$b_{2e}-b_{2w}=0.83193$,	$b_{3e}-b_{3w}=150.383$

TABLE XII. THE COMPARISON OF REGRESSION COEFFICIENTS (u)

$U = f_2$ (ADBL, MINIMUM LOAD REQUIREMENT, CONTAINER VOLUME)

<u>POD GROUP I</u>

$$u = \underset{(b_0)}{0.70168} + \underset{(b_1)}{0.05462}\sqrt{P} - \underset{(b_2)}{0.03714}\left(\frac{1}{ADBL}\right) = \underset{(b_3)}{121.88429}\left(\frac{1}{C}\right)$$

Standard error of b_1	0.00579
Standard error of b_2	0.00864
Standard error of b_3	2.75671
Standard error of estimate	0.0037
Multiple correlation	0.9933

<u>POD GROUP II</u>

$$u = \underset{(b_0)}{0.75165} + \underset{(b_1)}{0.08453}(\sqrt{P}) - \underset{(b_2)}{0.09272}\left(\frac{1}{ADBL}\right) + \underset{(b_3)}{48.07239}\left(\frac{1}{C}\right)$$

Standard error of b_1	0.00916
Standard error of b_2	0.02592
Standard error of b_3	4.35995
Standard error of estimate	0.0051
Multiple correlation	0.9573

<u>POD GROUP III</u>

$$u = \underset{(b_0)}{0.66204} + \underset{(b_1)}{0.12629}(\sqrt{P}) - \underset{(b_2)}{0.07548}\left(\frac{1}{ADBL}\right) + \underset{(b_3)}{101.24153}\left(\frac{1}{C}\right)$$

Standard error of b_1	0.01202
Standard error of b_2	0.01909
Standard error of b_3	5.71849
Standard error of estimate	0.0077
Multiple correlation	0.9695

TABLE XIII-(1). THE GROUP POD REGRESSION EQUATION (u)

POD GROUP IV

$$u = \underset{(b_0)}{0.45826} + \underset{(b_1)}{0.28383}(\sqrt{P}) - \underset{(b_2)}{0.39682}\left(\frac{1}{ADBL}\right) + \underset{(b_3)}{221.49507}\left(\frac{1}{C}\right)$$

Standard error of b_1	0.03986
Standard error of b_2	0.12815
Standard error of b_3	18.99580
Standard error of estimate	0.0220
Multiple correlation	0.9521

POD GROUP V

$$u = \underset{(b_0)}{0.31982} + \underset{(b_1)}{0.43454}(\sqrt{P}) - \underset{(b_2)}{1.74909}\left(\frac{1}{ADBL}\right) + \underset{(b_3)}{296.58838}\left(\frac{1}{C}\right)$$

Standard error of b_1	0.03343
Standard error of b_2	0.27020
Standard error of b_3	17.16138
Standard error of estimate	0.0174
Multiple correlation	0.9820

TABLE XIII-(2). THE GROUP POD REGRESSION EQUATION (u)

EQUATION: $y = C_0 + C_1\left(\frac{1}{ADBL}\right) + C_2\left(\frac{1}{C}\right)$

POD	MULTIPLE R	STANDARD ERROR ESTIMATE	C_0 INTERCEPT	C_1 $\frac{1}{ADBL}$	C_2 $\frac{1}{C}$	POD GROUP
W-1	0.9860	0.0111	0.66960	-0.82882 (220.7)	215.79355 (514.0)	
W-13	0.9944	0.0082	0.66315	-1.11101 (693.0)	243.93188 (1181.3)	
W-4	0.9806	0.0186	0.73059	-1.53667 (260.7)	260.59961 (265.0)	II
W-6	0.9858	0.0090	0.73883	-0.71796 (248.1)	169.96858 (477.8)	
W-7	0.9472	0.0059	0.84882	-0.15949 (28.6)	382.50244 (154.8)	
W-5	0.9919	0.0161	0.55626	-1.87864 (526.4)	382.50244 (761.8)	
W-10	0.9789	0.0187	0.47717	-1.03829 (118.8)	306.77539 (362.8)	III
W-9	0.9506	0.0229	0.69501	-1.30415 (117.6)	178.38411 (82.3)	
W-2	0.9848	0.0213	0.21555	-1.71051 (178.5)	444.37183 (576.8)	IV
W-8	0.9869	0.0201	-0.02460	-1.11073 (90.3)	468.20117 (727.9)	
W-3	0.9654	0.0309	0.16403	-1.98786 (82.0)	428.56128 (249.7)	
W-12	0.9860	0.0252	0.15833	-2.49939 (46.2)	659.75244 (670.2)	V

Note ( ): F values to enter

TABLE XIV-(1). REGRESSION SUMMARY (v = Step 2)

EQUATION: $y = C_0 + C_1(\frac{1}{ADBL}) + C_2(\frac{1}{C})$

POD	MULTIPLE R	STANDARD ERROR ESTIMATE	C_0 INTERCEPT	C_1 $\frac{1}{ADBL}$	C_2 $\frac{1}{C}$	POD GROUP
E-9	0.9225	0.0	0.99500	-0.00626 (0.0)	3.40083 (0.0)	I
E-11	0.9804	0.0178	0.58119	-0.68930 (255.3)	3.15308 (472.6)	
E-1	0.9771	0.0081	0.87644	-0.35369 (316.1)	103.56310 (297.0)	II
E-13	0.9394	0.0154	0.87600	-0.39128 (108.7)	120.59331 (110.6)	
E-4	0.8794	0.0234	0.60537	-0.17428 (2.1)	176.62120 (98.8)	IV

Note ( ): F values to enter

TABLE XIV-(2). REGRESSION SUMMARY (v: Step 2) (2)

$v = f_3$ (ADBL, MINIMUM LOAD REQUIREMENT, CONTAINER VOLUME)

Step 1 $\quad v = C_0 + C_1\,(ADBL) + C_2(C) + C_3(P \times C) + C_4\left(\frac{(P \times C)}{ADBL}\right)$

Step 2 $\quad v = C_0 + C_1\left(\frac{1}{ADBL}\right) + C_2\left(\frac{1}{C}\right)$

			(C_0)	(C_1)	(C_2)
Group I	East	$v_{1e} =$	0.58119	$- 0.68930\left(\frac{1}{ADBL}\right)$	$+ 288.15308\left(\frac{1}{C}\right)$
Group II	West	$v_{1w} =$	0.84882	$- 0.15949\left(\frac{1}{ADBL}\right)$	$+ 63.17688\left(\frac{1}{C}\right)$
	East	$v_{1e} =$	0.87644	$- 0.35369\left(\frac{1}{ADBL}\right)$	$+ 103.56310\left(\frac{1}{C}\right)$
			$C_{0e}-C_{0w}= 0.02762$,	$C_{1e}-C_{1w}= 0.19420$,	$C_{2e}-C_{2w}= 40.387$
Group III	West	$v_{1w} =$	0.62525	$- 0.77616\left(\frac{1}{ADBL}\right)$	$+ 246.76810\left(\frac{1}{C}\right)$
Group IV	West	$v_{1w} =$	0.60537	$- 0.17428\left(\frac{1}{ADBL}\right)$	$+ 176.62120\left(\frac{1}{C}\right)$
	East	$v_{1e} =$	0.69501	$- 1.30415\left(\frac{1}{ADBL}\right)$	$+ 178.38411\left(\frac{1}{C}\right)$
			$C_{0e}-C_{0w}= -0.08964$,	$C_{1e}-C_{1w}= 1.12987$,	$C_{2e}-C_{2w}= -1.76291$
Group Group V	West	$v_{1w} =$	0.15833	$- 2.49939\left(\frac{1}{ADBL}\right)$	$+ 659.75244\left(\frac{1}{C}\right)$

TABLE XV. COMPARISON OF REGRESSION COEFFICIENTS (v)

$v = f_3$ (ADBL, MINIMUM LOAD REQUIREMENT, CONTAINER VOLUME)

POD GROUP I

$$v = \underset{(C_0)}{0.58119} - \underset{(C_1)}{0.68930}\left(\frac{1}{ADBL}\right) + \underset{(C_2)}{288.15308}\left(\frac{1}{C}\right)$$

Standard error of C_1	0.04314
Standard error of C_2	13.25484
Standard error of estimate	0.0178
Multiple correlation	

POD GROUP II

$$v = \underset{(C_0)}{0.87644} - \underset{(C_1)}{0.35369}\left(\frac{1}{ADBL}\right) + \underset{(C_2)}{103.56310}\left(\frac{1}{C}\right)$$

Standard error of C_1	0.01989
Standard error of C_2	6.00959
Standard error of estimate	0.0081
Multiple regression	0.9771

POD GROUP III

$$v = 0.62525 - 0.77616\left(\frac{1}{ADBL}\right) + 246.76810\left(\frac{1}{C}\right)$$

Standard error of C_1	0.03700
Standard error of C_2	5.97070
Standard error of estimate	0.0069
Multiple correlation	0.9950

TABLE XVI-(1). THE GROUP POD REGRESSION EQUATION (v)

POD GROUP IV

$$v = \underset{(C_0)}{0.69501} - \underset{(C_1)}{1.30415}\left(\frac{1}{ADBL}\right) + \underset{(C_2)}{178.38411}\left(\frac{1}{C}\right)$$

Standard error of C_1	0.12025
Standard error of C_2	19.66429
Standard error of estimate	0.0229
Multiple correlation	0.9506

POD GROUP V

$$v = \underset{(C_0)}{0.15833} - \underset{(C_1)}{2.49939}\left(\frac{1}{ADBL}\right) + \underset{(C_2)}{659.75244}\left(\frac{1}{C}\right)$$

Standard error of C_1	0.36773
Standard error of C_2	25.48477
Standard error of estimate	0.0252
Multiple correlation	0.9860

TABLE XVI-(2). THE GROUP POD REGRESSION EQUATION (v)

COMPUTER PROGRAM ONE

STUFFING LIST GENERATION PROGRAM

(THIS PROGRAM WAS MODIFIED FOR OBTAINING ONLY ONE
CHAPTER OF STUFFING LIST)

```
//I1    EXEC PGM=IERRC000
//SORTLIB DD DSNAME=SYS1.SORTLIB,DISP=SHR
//SORTIN DD DSNAME=F0826.MT024,UNIT=2314,VOL=SER=LINDA,
//         DISP=(OLD,KEEP),LABEL=(,,,IN)
//SORTOUT DD DSNAME=&OUT,UNIT=SYSDA,DISP=(NEW,PASS),
//         DCB=(RECFM=FB,LRECL=23,BLKSIZE=3519),
//         SPACE=(TRK,6,RLSE)
//SORTPR DD SYSOUT=A,SPACE=(TRK,1,RLSE)
//SORTWK01 DD UNIT=SYSDA,SPACE=(TRK,(6,1),RLSE,CONTIG)
//SORTWK02 DD UNIT=SYSDA,SPACE=(TRK,(6,1),RLSE,CONTIG)
//SORTWK03 DD UNIT=SYSDA,SPACE=(TRK,(6,1),RLSE,CONTIG)
//SORTWK04 DD UNIT=SYSDA,SPACE=(TRK,(6,1),RLSE,CONTIG)
//SYSIN DD *
 SORT FIELDS=(18,2,CH,A,20,2,CH,A)

//I2 EXEC FORTCLGP,REGION.GO=99K
//FORT.SYSIN DD *
C       STUFFING LIST GENERATION PROGRAM
C       THIS PROGRAM GENERATES STUFFING LISTS
        IMPLICIT INTEGER*2(A-Z)
        INTEGER*4 CUT4
        REAL*4 PCT,FLOAT
        DIMENSION SAP(30 ),EAP(30 ),SAB(300 ),EAB(300 )
        DIMENSION CONGRP(1500),LOC(1500)
        DIMENSION  REC(10000)
        DIMENSION           SPCT(1500),CNS(1500),SLP(2,30 )
C      READ SORTED SEQUENCE FILE AND SET STARTING AND ENDING ADDRESSES.
        NCON=1
        NPOD=1
        NBBP=1
        READ(10,1)CONSEQ, LPODS,LBBPS,PERCNT
        SAP(1)=1
        SAB(1)=1
        LOC(1)=1
        SPCT(1)=PERCNT
        CNS(1)=CONSEQ
      4 READ(10,1,END=11) CONSEQ,  PODS,BBPS,PERCNT
      1 FORMAT(15X,4A2)
        IF(PODS.EQ.LPODS) GO TO 2
        LPODS=PODS
```

```
      EAP(NPOD)=NCON
      NPOD=NPOD+1
      SAP(NPOD)=NCON+1
    2 IF(BBPS.EQ.LBBPS) GO TO 3
      EAB(NBBP)=NCON
      NBBP=NBBP+1
      SAB(NBBP)=NCON+1
      LBBPS=BBPS
    3 NCON=NCON+1
      LOC(NCON)=NCON
      SPCT(NCON)=PERCNT
      CNS(NCON)=CONSEQ
      GO TO 4
   11 EAP(NPOD)=NCON
      EAB(NBBP)=NCON
      NSLA=NBBP+1
C     CREATE LEVEL 1 STUFFING LISTS
      PNTR=1
      DO 211 J=1,NPOD
      BEGIN=SAP(J)
      END=EAP(J)
 1112 FORMAT(10I7)
      SLP(1,J)=PNTR
      START=PNTR
      DO 212 K=BEGIN,END
      REC(PNTR)=PNTR+3
      REC(PNTR+1)=CNS(K)
      REC(PNTR+2)=NSLA
      PNTR=PNTR+3
  212 CONTINUE
      REC(PNTR-3)=START
  211 CONTINUE
C     SORT PERCENTAGES BY SIZE (ASCENDING ORDER)
      DO 21 I=1,NPOD
      BEGIN=SAP(I)
      END=EAP(I)-1
   34 FLAG=1
      DO 33 J=BEGIN,END
      IF(SPCT(J).LE.SPCT(J+1)) GO TO 33
      FLAG=2
      TEMP=SPCT(J)
      SPCT(J)=SPCT(J+1)
      SPCT(J+1)=TEMP
      TEMP=LOC(J)
      LOC(J)=LOC(J+1)
      LOC(J+1)=TEMP
   33 CONTINUE
      IF(FLAG.EQ.2) GO TO 34
```

```
   36 SUM=0
      END=END+1
C     ASSIGN GROUPS
      DO 35 J=BEGIN,END
      SUM=SUM+SPCT(J)
      GRP=1
      IF(SUM.LT. 900) GRP=GRP+1
      IF(SUM.LT. 600) GRP=GRP+1
      IF(SUM.LT. 300) GRP=GRP+1
      K=LOC(J)
      CONGRP(K)=GRP
   35 CONTINUE
   21 CONTINUE
      WRITE(7,7631)
 7631 FORMAT(' CONSIGNEE GROUP DATA FILE',39X,'05')
      WRITE(7,15)  (CNS(I),CONGRP(I),I=1,NCON)
   15 FORMAT(16(I4,I1))
      I=-1
      J=0
      WRITE(7,15) (I,J,K=1,16)
C     DO 111 I=1,4                                              ORIGINAL
      I=1                                                       MOD
      BC=0
C     PNTR=NCON*3 + 1                                           ORIGINAL
      PNTR=1                                                    MOD
      DO 112 J=1,NPOD
      BEGIN=SAP(J)
      END=EAP(J)
C     SLP(2,J)=PNTR                                             ORIGINAL
      SLP(1,J)=PNTR                                             MOD
      START=PNTR
  121 BC=BC+1
      FLAG=1
      STRT=SAB(BC)
      STP=EAB(BC)
      DO 122 L=STRT,STP
C     IF(CONGRP(L).LT.I) GO TO 122                              ORIGINAL
      FLAG=2
      REC(PNTR)=PNTR+3
      REC(PNTR+1)=CNS(L)
      REC(PNTR+2)=0
      PNTR=PNTR+3
  122 CONTINUE
      IF(FLAG.EQ.2) REC(PNTR-1)=BC
      IF(STP  .LT.END) GO TO 121
      IF(PNTR.EQ.START) GO TO 123
      REC(PNTR-3)=START
      GO TO 112
```

```
  123 SLP(2,J)=0
  112 CONTINUE
C     NSLVL=2                                                    ORIGINAL
      NSLVL=1                                                    MOD
      NLSA=NBBP                                                  MOD ADD.
      WRITE(7,151) NSLVL,NSLA,I
  151 FORMAT(' ORDERED STUFFING LIST FILE    ',35X,
     *          '05', I2,I3,I4)
      NDATA=PNTR-1
      WRITE(7,152) NDATA,((SLP(L,K),L=1,NSLVL),K=1,NPOD)
  152 FORMAT(12I6)
      WRITE(7,153) (REC(K),K=1,NDATA)
  153 FORMAT(6(I5,I4,I3))
      PCT=1.0
      WRITE(7,154)(PCT,L=1,NSLA)
  154 FORMAT(18F4.2)
  111 CONTINUE
      STOP
      END

//GO.FT10F001 DD DSNAME=&OUT,UNIT=SYSDA,DISP=(OLD,DELETE)
```

COMPUTER PROGRAM TWO

POD OPERATIONS SUMMARY SELECTION PROGRAM

```
STANDARD JOB CONTROL CARD
// EXEC FORTCLGP
//FORT.SYSIN DD *
C       POD OPERATIONS SUMMARY SELECTION PROGRAM
C       THIS PROGRAM SELECTS SPECIFIC SIMULATION OUTPUT DATA FROM
C            THE POD OPERATIONS SUMMARY CARD FILE, AND PUNCHES IT ON
C          CARDS.  THESE CARDS , IN TURN, ARE USED IN REGRESSION
C            PROGRAMS.  THESE PUNCHED CARDS ARE REFERRED TO AS THE
C            PERFORMANCE TRADE OFFS REGRESSION CARD FILE.
C       FILE 11 IS THE FILE CONTAINING THE POD OPERATIONS SUMMARY CARD
C            IMAGES FOR THE RUNS WHOSE DATA IS BEING SELECTED.
C       THE FIRST PORTION OF THE PROGRAM SCANS THE DATA FILE IN ORDER
C           TO DETERMINE ITS STRUCTURE.
C       THE SECOND PHASE SELECTS AND SUMMARIZES DATA FOR
C            PUNCHING ON CARDS.
C       NR= NUMBER OF RUNS
C       NP= NUMBER OF PODS
C       NC(I,J) = NUMBER OF CONTAINER TYPES USED FOR POD (I), RUN (J).
        IMPLICIT INTEGER*2 (A-W)
        IMPLICIT INTEGER*4 (X)
        IMPLICIT REAL*4 (Y)
        IMPLICIT REAL*8 (Z)
        DIMENSION NPR(40)
        DIMENSION  NC(30,40)
        NR=0
      3 READ(11,2,END=8) P,C,XRN1,XRN2
      2 FORMAT(I2,I1,69X,2A4)
        IF(NR.EQ.0) GO TO 7
        IF((XLR1.NE.XRN1).OR.(XLR2.NE.XRN2)) GO TO 5
        IF(LP.EQ.P) GO TO 4
        NC(NP,NR)=(NCPC-2)/3
      6 NP=NP+1
        LP=P
        NCPC=0
      4 NCPC=NCPC + 1
        GO TO 3
      5 NPR(NR)=NP
        NC(NP,NR)=(NCPC-2)/3
      7 NR=NR+1
        XLR1=XRN1
        XLR2=XRN2
        NP=0
        GO TO 6
      8 NC(NP,NR)=(NCPC-2)/3
```

```
      NPR(NR)=NP
      WRITE(6,11) NR,NP
   11 FORMAT(' NUMBER OF RUNS=',I5,'.   NUMBER OF PODS IN LAST RUN=',I5)
      REWIND 11
      DO 21 J=1,NR
      NP=NPR(J)
      DO 21 I=1,NP
      READ(11,22) POD, YNS,YTM,YSV,YSC,YVU,IRN1,BLT1,IXRN2             MOD
   22 FORMAT(I2,1X,F8.0,F5.2,5X,F10.0,2F6.4,29X,I2,A4,I2)              MOD
      NCT=NC(I,J)                                                      MOD
      READ(11,26) XDUMMY                                               MOD
   26 FORMAT(A4)                                                       MOD
      XTNS=0                                                           MOD
      XTNSCS=0                                                         MOD
      XTNMXS=0                                                         MOD
      DO 23 K=1,NCT                                                    MOD
      READ(11,24) XNSCS,XNMXS                                          MOD
   24 FORMAT(  9X,I8)                                                  MOD
      READ(11,35) XNLS,YBLT                                            MOD
   35 FORMAT(  9X,I8,16X,F6.2)                                         MOD
      XTNSCS=XTNSCS+XNSCS                                              MOD
      XTNMXS=XTNMXS+XNMXS                                              MOD
   23 XTNS=XTNS + XNLS                                                 MOD
      YSPSC=FLOAT(XTNSCS)/FLOAT(XTNS)                                  MOD
      YSPMX=FLOAT(XTNMXS)/FLOAT(XTNS)                                  MOD
      YMC=1.-YSC                                                       MOD
      YCSJ= YSC*YVU                                                    MOD
      YCMC=YMC*YVU                                                     MOD
      IF((IRN1.EQ.20).AND.(IXRN2.EQ.10)) GO TO 27                      MOD
      IF((IRN1.EQ.20).AND.(IXRN2.EQ.07)) GO TO 28                      MOD
      IF((IRN1.EQ.20).AND.(IXRN2.EQ.13)) GO TO 29                      MOD
      IF((IRN1.EQ.20).AND.(IXRN2.EQ.16)) GO TO 30                      MOD
      IF((IRN1.EQ.40).AND.(IXRN2.EQ.10)) GO TO 47                      MOD
      IF((IRN1.EQ.40).AND.(IXRN2.EQ.07)) GO TO 48                      MOD
      IF((IRN1.EQ.40).AND.(IXRN2.EQ.13)) GO TO 49                      MOD
      IF((IRN1.EQ.40).AND.(IXRN2.EQ.16)) GO TO 50                      MOD
   27 YBAFAD=1.0*YBLT                                                  MOD
      WRITE(7,31) POD,YTM,YVU,YSC,YSPSC,YMC,YSPMX,YBLT,IRN1,BLT1,IXRN2 MOD
      GO TO 21                                                         MOD
   28 YBAFAD=0.7*YBLT                                                  MOD
      WRITE(7,32) POD,YTM,YVU,YSC,YSPSC,YMC,YSPMX,YBLT,IRN1,BLT1,IXRN2 MOD
      GO TO 21                                                         MOD
   29 YBAFAD=1.3*YBLT                                                  MOD
      WRITE(7,33) POD,YTM,YVU,YSC,YSPSC,YMC,YSPMX,YBLT,IRN1,BLT1,IXRN2 MOD
      GO TO 21                                                         MOD
   30 YBAFAD=1.6*YBLT                                                  MOD
      WRITE(7,34) POD,YTM,YVU,YSC,YSPSC,YMC,YSPMX,YBLT,IRN1,BLT1,IXRN2 MOD
      GO TO 21                                                         MOD
```

```
   47 WRITE(7,41) POD,YTM,YVU,YSC,YSPSC,YMC,YSPMX,YBLT,IRN1,BLT1,IXRN2    MOD
      GO TO 21                                                             MOD
   48 WRITE(7,42) POD,YTM,YVU,YSC,YSPSC,YMC,YSPMX,YBLT,IRN1,BLT1,IXRN2    MOD
      GO TO 21                                                             MOD
   49 WRITE(7,43) POD,YTM,YVU,YSC,YSPSC,YMC,YSPMX,YBLT,IRN1,BLT1,IXRN2    MOD
      GO TO 21                                                             MOD
   50 WRITE(7,44) POD,YTM,YVU,YSC,YSPSC,YMC,YSPMX,YBLT,IRN1,BLT1,IXRN2    MOD
   31 FORMAT(I3,F5.2,5F6.4,F6.2,' 0.50 ',' 1120.0 ',14X,I2,A4,I2)          MOD
   32 FORMAT(I3,F5.2,5F6.4,F6.2,' 0.35 ',' 1120.0 ',14X,I2,A4,I2)          MOD
   33 FORMAT(I3,F5.2,5F6.4,F6.2,' 0.65 ',' 1120.0 ',14X,I2,A4,I2)          MOD
   34 FORMAT(I3,F5.2,5F6.4,F6.2,' 0.80 ',' 1120.0 ',14X,I2,A4,I2)          MOD
   41 FORMAT(I3,F5.2,5F6.4,F6.2,' 0.50 ',' 2390.0 ',14X,I2,A4,I2)          MOD
   42 FORMAT(I3,F5.2,5F6.4,F6.2,' 0.35 ',' 2390.0 ',14X,I2,A4,I2)          MOD
   43 FORMAT(I3,F5.2,5F6.4,F6.2,' 0.65 ',' 2390.0 ',14X,I2,A4,I2)          MOD
   44 FORMAT(I3,F5.2,5F6.4,F6.2,' 0.80 ',' 2390.0 ',14X,I2,A4,I2)          MOD
   21 CONTINUE
      STOP
      END

//GO.FT11FC01 DD UNIT=2314,DSNAME=F2980.EASTDT9,DISP=(OLD,KEEP),
//        VOLUME=SER=DUFFY,LABEL=(,,,IN)

//GO.FT11F001 DD UNIT=2314,DSNAME=F2980.EASTDT2,DISP=(OLD,KEEP),
```

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